M/035/015

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Frederick D. Fox
Director, Environmental Affairs

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Kennecott

February 3, 1995

Ms. Lisa Rogers
Utah State Department of Environmental Health
Division of Water Quality
288 North 1460 West
P.O. Box 144870
Salt Lake City, Ut 84114-4870

Subject: Demonstration Project for the Application of Biosolids in the Reclamation of the Tailings Impoundment

Dear Ms. Rogers:

Attached is the first annual report of the demonstration project for the Application of Municipal Biosolids to the Kennecott Tailings Impoundment. This report satisfies our 1994 reporting requirement for the application of the sludge to the Tailings Impoundment.

If you have comments or require additional information, please contact me at 569-6555, or Ric Jones at 569-6640.

Yours truly yours,

Frederick D Fox

Frederick D. Fox

FDF\RJ:bt

Enclosure

cc: D. Wayne Hedberg, DOGM
Bob Brobst, EPA Region VII
Melvin Muir, Salt Lake City/County Health Depart.

DEMONSTRATION PROJECT

FOR

THE APPLICATION OF MUNICIPAL BIOSOLIDS TO THE KENNECOTT TAILINGS IMPOUNDMENT

RECEIVED
FEB - 6 1995
DIV OF OIL, GAS & MINING

Interim Report Submitted to

Division of Water Quality
Department of Environmental Quality
State of Utah

Under STATE CONTRACT NO. 95 1470

February 1, 1995

by

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1. Introduction

The biosolids demonstration project is a cooperative effort between Kennecott Utah Copper (KUC), the Department of Mining Engineering of the University of Utah and the Central Valley Water Reclamation Facility (CVWRF). The purpose of this project is to determine the success of vegetative growth after a one-time application of biosolids to the slopes of the KUC tailings impoundment, near Magna, Utah. Anaerobically digested (Class B) sewage sludge from the CVWRF was used as biosolids. The Magna Improvement District also provided aerobically digested (Class B) biosolids for one of the test sites. The one time application of biosolids was made in the designated test sites (outlined in Section 7). The test site soils will be sampled for metals and agronomic properties before and after the application of biosolids. The sites will be evaluated for 1, 2, 3, 5, and 10 years after the initial application for biomass production and above ground species diversity.

This report summarizes the project - its experimental design, site locations, EPA regulations concerning the project, metal analyses, and the current status of the project.

2. Purpose and Objectives of the Project

The objectives of the demonstration project are:

1. To determine if there are improvements in the physical, chemical and biological properties of the tailings after amendment with biosolids.

2. To monitor the potential mobility of soluble metals in the applied biosolids.

3. To determine the treatments and amendments necessary to enhance plant growth and to develop specifications for the safe application of biosolids. The specifications will include biosolids application rates; fertilization, if required; recommend seed mixtures; erosion protection measures; and monitoring and maintenance requirements.

4. The ultimate objective is to enhance the permanent vegetative cover on the tailings impoundment capable of self-regeneration and plant succession.

3. Importance of this Project

In the past, research into the use of biosolids as a soil amendment has been conducted in humid climates, with very little research performed in the semi-arid climate that is typical of Utah. This project is a first of its kind in terms of scale and scope - almost 80 acres of land are being used as test sites.

4. U.S. EPA 40 CFR 503 Regulations

The Environmental Protection Agency published the final rules for the disposal of municipal sewage sludge on February 19, 1993 in the Federal Register, 40 CFR Parts 257, 403, and 503. These regulations were promulgated under authority of Sections 405 (d) and (e) of the Clean Water Act, as amended. One section of the regulations permits the application of sewage sludge to land for beneficial use (as biosolids), e.g., for land reclamation. The regulations acknowledge the value of biosolids by the following quote:

"One important avenue for sewage sludge disposal is through beneficial use and recycling projects. Sewage sludge is a valuable resource. The nutrients and other properties commonly found in sludge make it useful as a fertilizer and soil conditioner. Sludge has been used for its beneficial qualities on agricultural lands, in forests, for landscaping projects, and to reclaim strip-mined lands."

The 503 regulations establish requirements for sewage sludge (biosolids) when the biosolids are applied to the land for beneficial purposes. The regulations also establish standards for the disposal of sludge in surface disposal sites (landfills) and for disposal by incineration.

5. Biosolids - Characteristics

Extensive research has shown that stabilized biosolids is an excellent soil amendment and chemical fertilizer substitute. Biosolids improves soil characteristics in the following ways (Sopper 1993):

1. Biosolids improves the physical properties of soil: water holding capacity, bulk density, organic matter content, surface temperatures, long term fertility and horizonation of soil.

2. It improves the chemical properties of soil: pH, CEC, and thus controls the releases of trace metals.

3. It improves the biological properties of soil - humification, soil aggregation, and nitrogen cycling, soil community respiration, thus achieving the long term goal of soil ecosystem development and stability.

4. Infertile soils amended with chemical fertilizers, unlike biosolids-amended soils, require extensive time periods, often as long as 20 years for buildup of microbial populations, which is an indicator of biological activity in the soil profile.

5. Biosolids facilitates rapid establishment and vigorous growth of plant species.

The CVWRF biosolids -as a dry belt filter press cake- has been analyzed for the 40 CFR 503 regulated metals. The agronomic rate has also been calculated. Both analyses were based on average and maximum test results from January 3 to March 1, 1994. These analyses are attached as appendix 1. The appendix also includes average results for percent solids and nitrogen from November 19 and 29, 1993. Similar analyses were performed on the Magna biosolids. The Magna biosolids test results are attached as appendix 2.

In the appendix, the maximum calculated biosolids application rate for the CVWRF biosolids is 35.7 dry tons/acre. The maximum calculated biosolids rate for the Magna biosolids is 69.0 dry tons/acre. These application rates are based on the metals content of the biosolids. These calculated application rates are greater than the maximum rate of 30 dry tons/acre that was actually applied to the tailings impoundment. Thus, the application of biosolids is within the Table 4 limitations of 40 CFR 503.

An agronomic rate of 2.1 dry tons/acre was also calculated in appendix 1. The agronomic rate is based on nitrogen requirements of the crop that will be grown on the impoundment. However, for reclamation purposes, a higher one-time application rate may be used.

Analyses for the regulated metals was performed on a continuing basis by CVWRF during the time of application of biosolids to the impoundment. The number of tests performed by CVWRF exceeded the number of tests required by 40 CFR 503. Table 1 lists the values for each of 40 CRF 503 metals as analyzed by CVWRF. *At no time were the regulatory limits exceeded.*

6. Experimental Design

The experimental design consists of single-factor linear design that utilizes randomized complete plots for all the test sites. This design was chosen because of its suitability in reducing experimental error due to known sources of variation, eg., variation in pH or other properties of the tailings across each test site. Each test site has been divided into plots of approximately one acre each. The width of each plot was kept close to 100 feet to facilitate biosolids application. The number of plots in each site is in a multiple of 4, except for site No. 3b, which has eleven one-acre plots. Thus, there generally are an equal number of test plots for each application rate, per site. Each test plot receives one of the four different treatments of sludge, applied on a random basis, as given by Figures 1 through 4. The application rates are 0 dry tons/acre (control), 10 dry tons/acre, 20 dry tons/acre, and 30 dry tons/acre.

Table 1 - CVWRF Dry Belt Filter Press Cake Metal Data (ppm)

Date	As	Cd	Cr	Cu	Hg	Mo	Ni	Pb	Se	Zn
1 Aug	5.8	5.1	141.9	504.9	3.0	57.5	57.6	230.6	11.2	1020.0
8 Aug	5.5	5.6	126.0	533.5	4.1	46.7	67.9	317.0	8.5	1041.7
10 Aug	0.8	5.1	100.9	473.9	2.6	45.3	54.3	308.2	--	831.3
15 Aug	2.6	6.8	126.6	520.9	2.6	46.5	--	301.0	8.7	953.2
22 Aug	2.9	6.8	112.4	581.9	3.2	43.8	--	308.0	15.8	1032.5
29 Aug	9.7	11.2	101.6	552.0	1.5	50.2	45.6	321.3	14.1	993.8
6 Sept	5.8	6.2	78.1	506.7	2.8	45.6	35.6	238.9	17.8	910.0
12 Sept	11.2	7.0	71.9	485.3	3.0	57.2	18.2	219.4	17.7	863.3
19 Sept	11.2	8.0	77.1	542.9	2.5	56.7	35.9	228.4	18.4	1011.5
26 Sept	4.1	5.8	84.3	586.6	1.6	59.7	66.3	264.2	15.2	1034.4
3 Oct	0.1	7.2	83.7	644.6	1.1	46.1	60.8	234.3	23.5	1235.0
10 Oct	4.6	5.7	62.1	552.9	1.1	47.4	55.8	204.4	11.9	1099.1
17 Oct	14.8	7.5	57.5	575.2	2.5	55.7	45.7	130.4	9.8	978.4
24 Oct	5.8	8.7	78.8	650.4	2.6	--	41.8	250.9	12.5	1422.8
Ave.	6.1	6.9	92.9	550.4	2.7	51.0	48.0	255.5	14.2	1030.5
Max.	*14.8*	*11.2*	*141.9*	*650.4*	*4.5*	*59.7*	*66.3*	*321.1*	*23.6*	*1422.8*
Min.	0.1	5.1	57.5	473.9	1.1	43.8	18.2	130.4	8.5	831.3
Limit	*75*	*85*	*3000*	*4300*	*57*	*75*	*420*	*840*	*100*	*7500*

6.1. Project Site Descriptions and Locations

The tailings pond covers an area of approximately 5600 acres. All project sites are located on the slopes of the tailings impoundment. The property is fenced and locked from public access. The depth to the first major aquifer is 230 feet. The distance from the nearest drinking water well is one-quarter mile.

The following five test sites were chosen for slope aspect and tailings conditions:

1. Test Site No. 1 : Northwest-facing, 8 to 1 slope, 19 acres. This test site is subjected to severe drying conditions from persistent winds. This test site is also subject to lower pH conditions (range: 2.6 to 7.7). Slaked lime has been applied at a rate of 6 tons/acre prior to the application of biosolids. Growth of trees already present will also be evaluated at this site. This site has been divided into 16 one-acre plots.

2. Test Site No. 2: Northwest-facing, 8 to 1 slope, 16 acres. This test site is also subjected to severe drying conditions from persistent winds. This test site is also subject to low pH conditions (range: 3.1 to 7.8) and would be compared to test sites No. 1 and 3. Biosolids only have been applied to this test site. Trees are also present on this test site. This site has been divided into 16 one-acre plots.

3. Test Site No. 3: Northwest-facing, 8 to 1 slope, 18 acres. This test site is also subjected to severe drying conditions from persistent winds and low pH conditions (range: 2.8 to 7.9). Wood chips have been applied at the rate of 30 tons/acre prior to the application of biosolids. This site has been divided into 16 one-acre plots.

4. Test Site No. 3b: Northwest-facing, 8 to 1 slope, 11 acres. This test site is adjacent to Test Site No. 3. This site has been divided into 16 plots of approximately one-half to three-quarter acre each. Aerobically digested (Class B) biosolids from the Magna wastewater treatment plant have been applied. Analytical results for this material are given in Appendix 2.

5. Test Site No. 4: North-facing, 8 to 1 slope, approximately 18 acres. This test site includes tailings which have been recently deposited. Biosolids only have been applied to this site. This site has been divided into 18 plots of approximately one acre each.

7. Scope of work

Prior to the initiation of the field work, a work plan, field sampling plan, and safety, health and environmental plans were written for this demonstration project by KUC personnel. Extensive quality control/quality assurance measures have been incorporated into the project to ensure that field and laboratory performance will conform to proper sampling and testing protocols.

7.1 Sampling Runs

The test sites will be monitored two times for chemical and agronomic characteristics in the first year, and annually for the next two years of the study. Additional test runs will be performed in the fifth and tenth years of the study. Initial soil variability will be determined from baseline data collection, which was completed prior to the application of biosolids.

Agronomic Testing

Tailings from within the top six inches of depth will be tested for agronomic properties, as given by Table 2 below. The table summarizes the agronomic test, test procedure number, and comments for each test (Black, 1965). The samples will be composited according to the biosolids application rate. Thus, each test site will provide four composited samples. Each sample will then be split into two, one of which will be held in storage and the other will be tested by an independent laboratory (Utah State University).

Chemical Analyses

Samples for chemical testing will be collected to a total depth of 5 feet from the plots receiving 30 tons/acre of sludge for every test site. Samples will be collected at depths of 0, 1, 3, and 5 feet. Approximately 500 grams of material are collected for each sample. Table 3 lists the metals, as required by 40 CFR 503, for which tests will be performed. The samples will be split; one split will be tested by Kennecott Environment Laboratory (KEL), the other will be held in storage, and some of split samples will be used for QA/QC testing. The metals will be extracted from the tailings using extraction method 3050 (SW-846). Table 3 summarizes the chemical test, test procedure number and the detection limits for each test.

Sampling QA/QC

To evaluate the precision and accuracy of the testing program, samples will be split and re-tested, one for every ten samples. Standard samples, to be included in the testing program, have been prepared previously, and will also be tested, one for every 20 samples tested.

Table 2 - Agronomic Test Series

Agronomic Test	Utah State University Method	Detection Limits
pH	Saturated Paste	1.0-14.0 mg/L
SAR	Calculated from Ca, Mg, Na	0.01 mg/L
Kjeldahl Nitrogen	Kjeldahl Nitrogen	0.01 %
N as nitrate	$Ca(OH)_2$ extraction with analysis by chromatropic acid	0.1 mg N/kg
Cation Exchange Capacity	1.0 N NHO_4Ac, pH 7	0.1 mg/100g
Organic Matter Content	Walkely-Black	0.01 %
Soil Texture	Hydrometer	1 %
Phosphorus (available)	Olsen: $NaHCO_3$, pH 8.5	0.1 mg P/kg
Cd, Cr, Cu, Ni, Pb	DTPA	0.2 mg/kg
Fe	DTPA	0.2 mg/kg
Mn	DTPA	0.2 mg/kg
Ca	Saturated Paste/ICP	0.15 mg/L
Na	Saturated Paste/ICP	0.2 mg/L
Mg	Saturated Paste/ICP	0.15 mg/L
K (available)	Olsen Bicarbonate, pH 8.5	5 ppm
Water Holding Capacity	Pressure Plate: 1/3, 15 bar mass water content	1 %

Table 3 - Chemical Test Program

Chemical Test	SW-846 Test Number	Detection Limits (mg/L)
pH	Method 61-3*	N/A
organic matter	Method 92-3*	2% precision
arsenic	6020	0.5
cadmium	6020	0.2
chromium	6020	1
copper	6020	1
lead	6020	0.5
mercury	7471	0.01
molybdenum	6020	1
nickel	6020	1
selenium	6020	0.5
zinc	6020	1

*from *Methods of Soil Analysis, Part 2* (1965).

Biomonitoring Sampling

Vegetation establishment will be compared with the control plots for each test site, and its success determined as a function of measured species diversity and biomass production measured by one transect across the plot (line intercept method as given by Chambers and Brown, 1983). Within each selected plot, vegetation will be identified by transect and bagged by individual species. Species diversity will be calculated directly from the field notes and sample collection. The species diversity transects will be performed in the spring of 1995, 1996 and 1997. Biomass measurements will be taken in the fall of 1995, 1996 and 1997. For biomass production, plant species will be harvested from the center of the test plot, dried and weighed to obtain total above-ground biomass and species-weighted biomass results.

7.2 Biosolids Application

The biosolids were delivered by CVWRF trucks to the selected staging areas next to the test sites. Approximately 120 wet tons of wet biosolids were delivered per day. From the staging area, a front-end loader loads the biosolids onto an applicator (termed a "slinger") which then spreads the biosolids on the plot, as per the application rate decided upon for the particular plot. The following color scheme was used to paint the signboards on the stakes at each corner of each plot, which guided the slinger driver as to the application rate of biosolids for the particular plot. Magna biosolids were applied with a manure spreader by a KUC contractor.

Orange - 30 dry tons/acre
Red - 20 dry tons/acre
Blue - 10 dry tons/acre
White - 0 dry tons/acre (control)
Green - transect and road markers

The biosolids application was completed in November of 1994.

7.3 Seed Mix

In the spring of 1995, KUC personnel will apply by drill-seeder, to all test sites, the anticipated seed mix given in Table 4, depending on species availability.

Table 4 - Biosolids Land Application Seed Mix

Common Name	Scientific Name	PLS (lbs/acre)
Stabilization Cover Crop:		
Winter Rye	*Secale cereale*	30
Perennial Mix:		
Yellow Sweetclover	*Mililotus officinalis*	3
Tall wheatgrass	*Agropyron elongatum*	3
Sheep fescue	*Festuca ovina*	3
Alfalfa (Ranger)	*Medicago sativa*	5
Winter rye	*Secale cereale*	10

8. Current Status of the Project

1) Sites 1, 2, 3, 3b, and 4 have been laid out and marked as given by the work plan.
2) All baseline samples have been taken from these sites.
3) Biosolids application was completed on all sites.
   a) Lime was added to site 1 at the rate of 6 tons per acre prior to the application of biosolids.
   b) Sites 2 and 4 have received biosolids only.
   c) Site 3, prior to the application of sludge, received green waste at the rate of 30 tons/acre.
   d) Biosolids from the Magna Wastewater Treatment Plant was applied to site 3b.
4) Additional sampling for agronomic properties was completed in December 1994.
5) All prepared sites will be planted in the early spring of 1995.

Figures 5 through 16 present an approximate chronological sequence of photographs which illustrates each of the important events in the biosolids project to date.

9. References

1. Black, C. A. (Ed.). Methods of Soil Analysis, Part 2, Chemical and Microbiological Properties, No. 9 in the series Agronomy, American Society of Agronomy, Inc., Madison, Wisconsin, 1965.

2. Chambers, Jeanne C. and Ray W. Brown. "Methods for Vegetation Sampling and Analysis on Revegetated Mined Lands." General Technical Report INT-151, Intermountain Forest and Range Experiment Station, Ogden, Utah, October 1983.

3. "Surface Coal Mining and Reclamation Permanent Program Regulations; Revegetation." Federal Register 47 No. 56: 12596-604. Part VI, March 23, 1982.

4. 40 CFR Parts 257, 403, and 503, U.S. GPO, Washington, D.C.

5. Nielson, Rex F., and H. B. Peterson. "Treatment of mine tailings to promote vegetative stabilization," Bulletin 485. Agricultural Experiment Station, Utah State University, June 1972.

6. Sopper, W. *Municipal Sludge Use in Land Reclamation*. University Park, PA: The Pennsylvania State University Press, 1993.

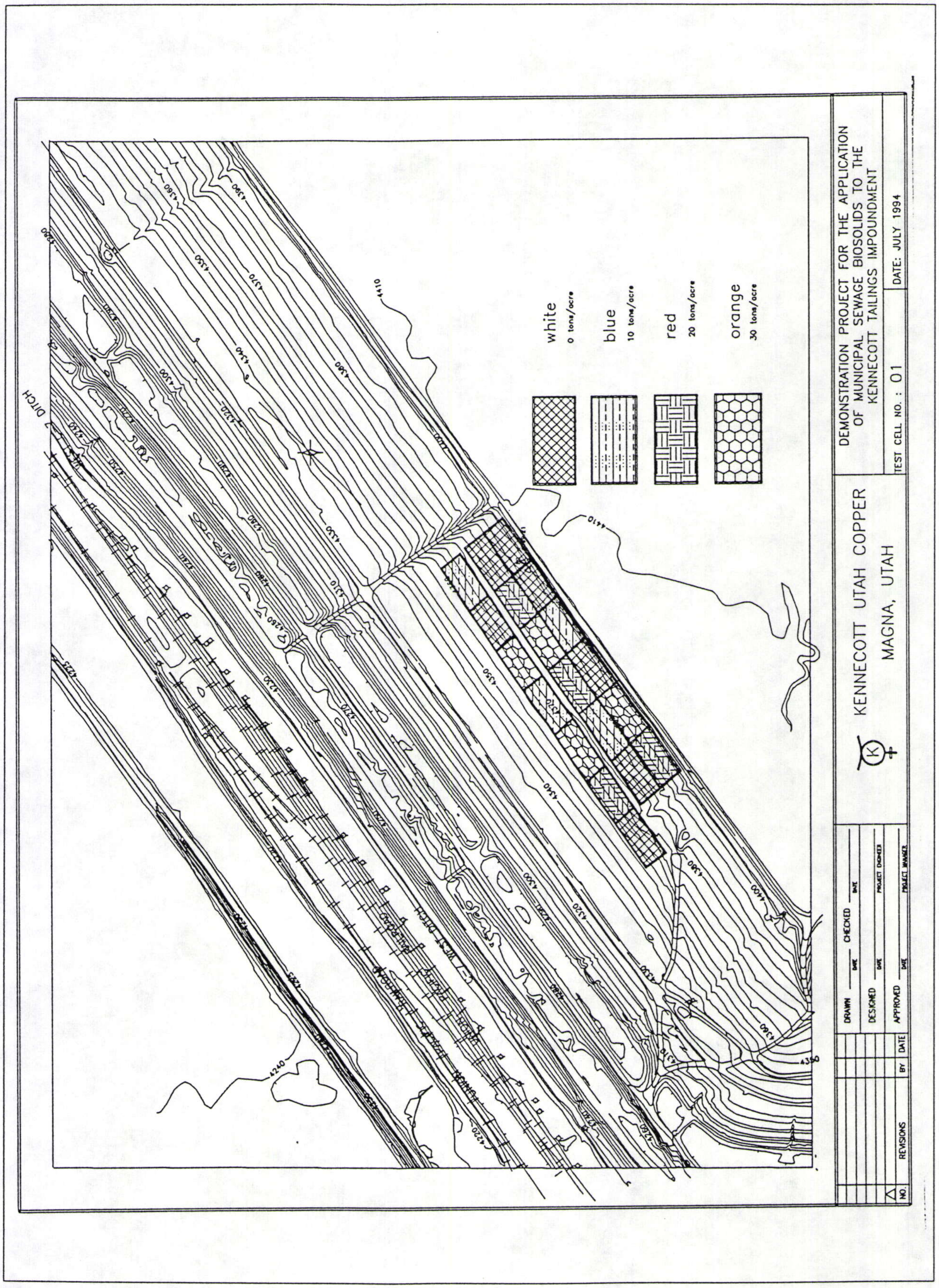

Figure 1- Test Site No. 1, Biosolids Application Rates

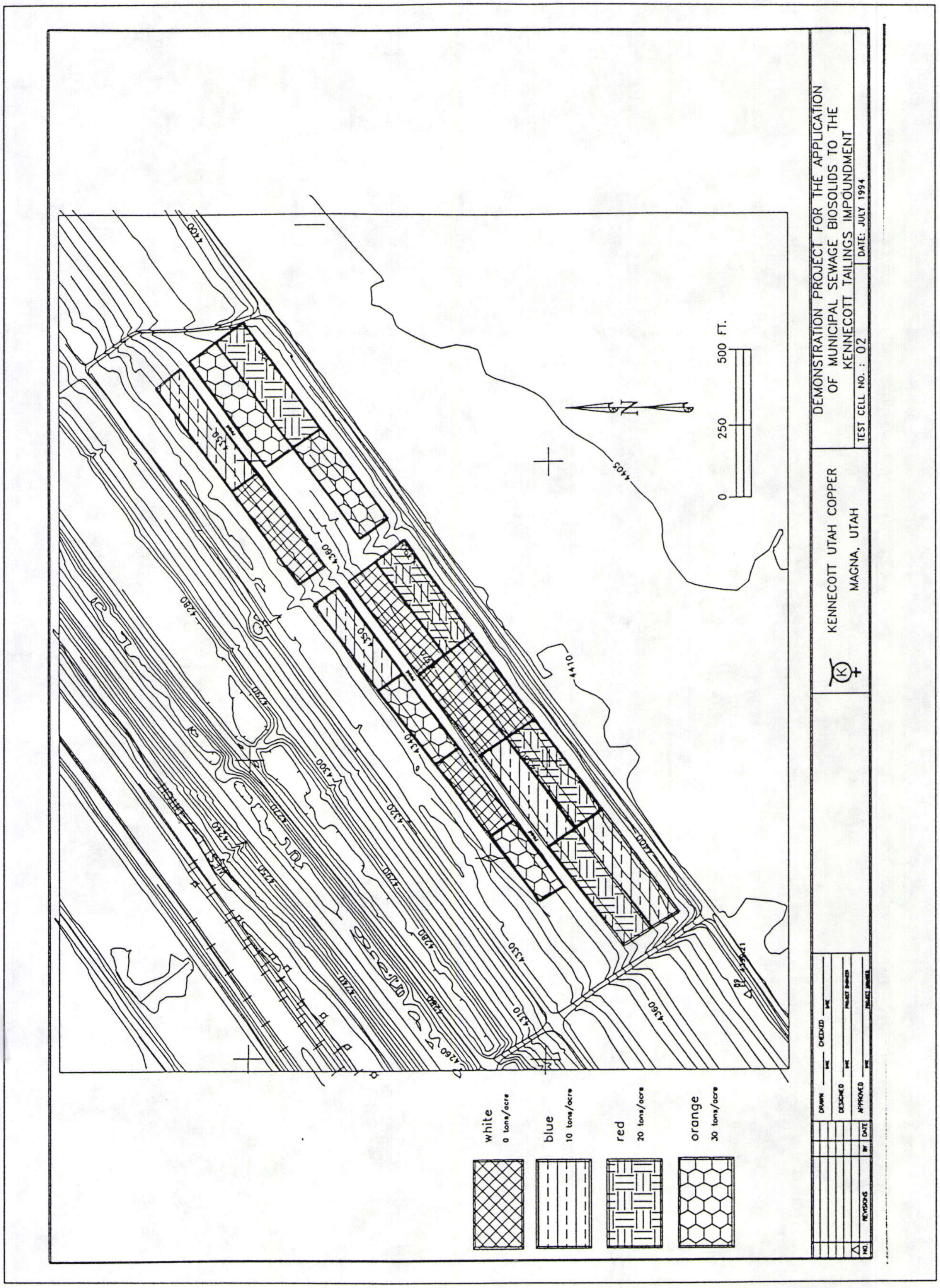

Figure 2 - Test Site No. 2, Biosolids Application Rates

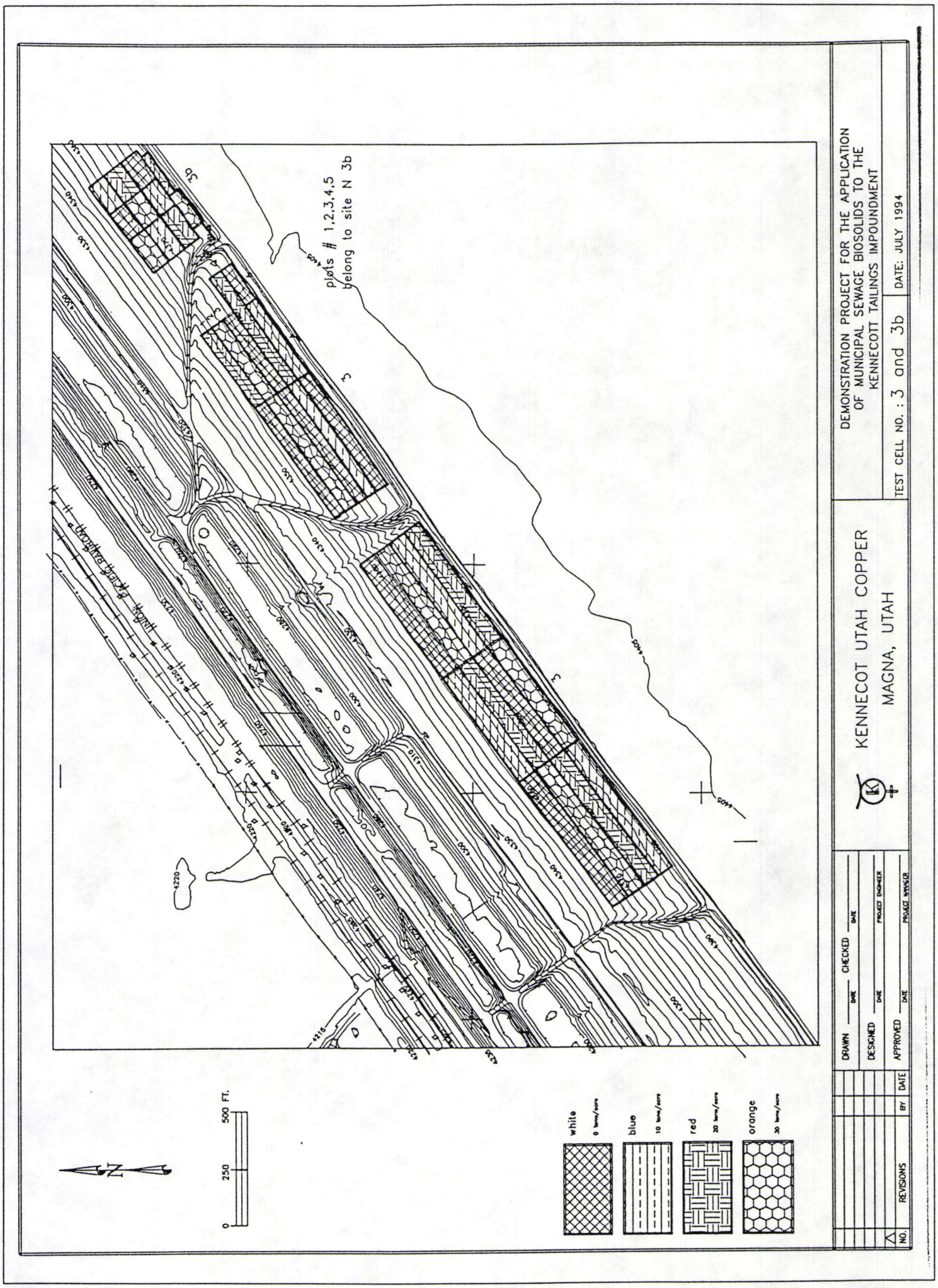

Figure 3 - Test Sites No. 3 and 3b, Biosolids Application Rates

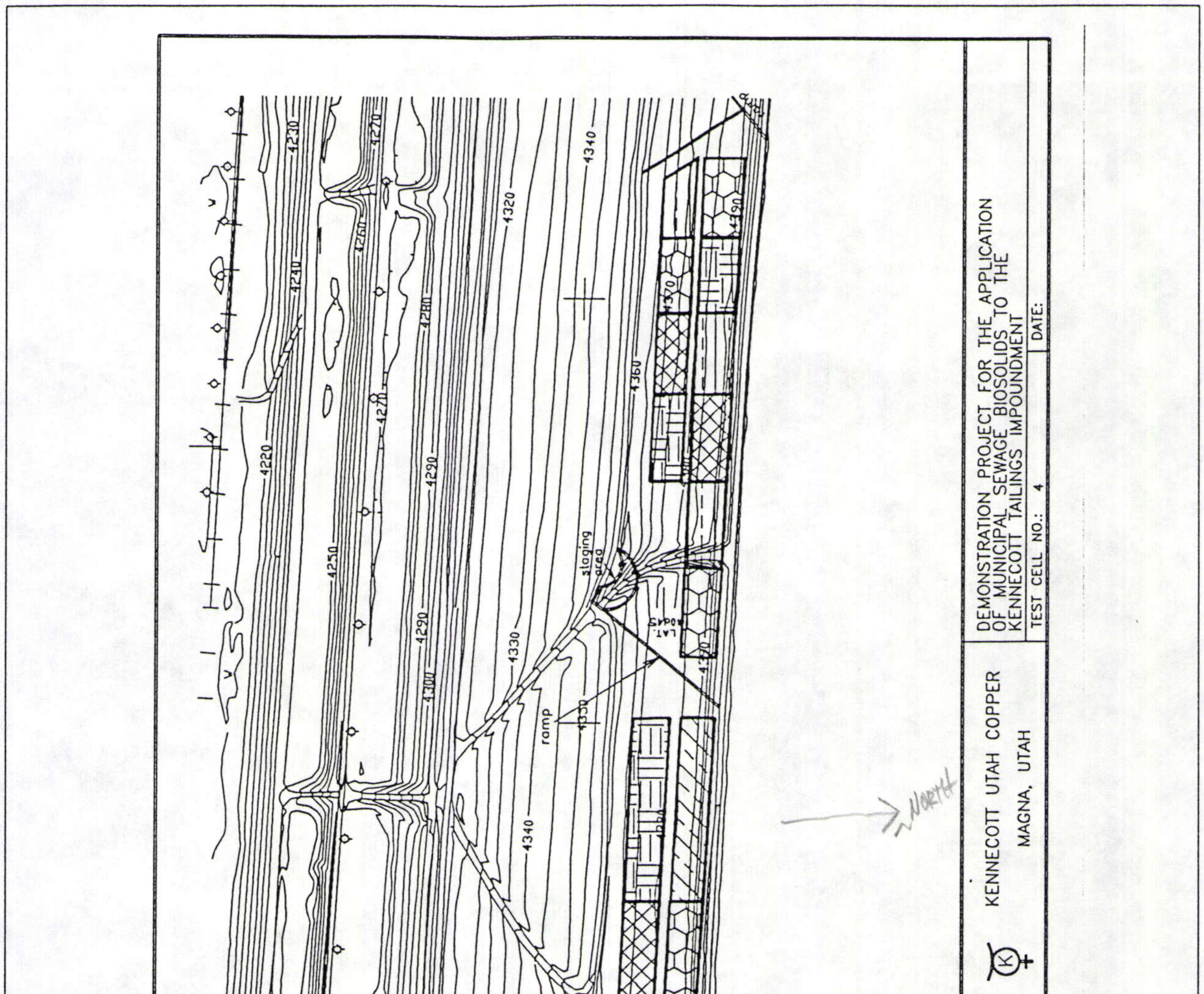

Figure 4 - Tests Site No. 4, Biosolids Application Rates

Figure 5 - Test Site prior to biosolids application

Figure 6 - CVWRF truck delivering biosolids

Figure 7 - CVWRF equipment loading biosolids

Figure 8 - Biosolids application equipment

Figure 9 - Loading biosolids prior to application

Figure 10 - Biosolids application marker (orange - 30 dry tons/acre)

Figure 11 - Biosolids disked after application

Figure 12 - Test pit for chemical sampling

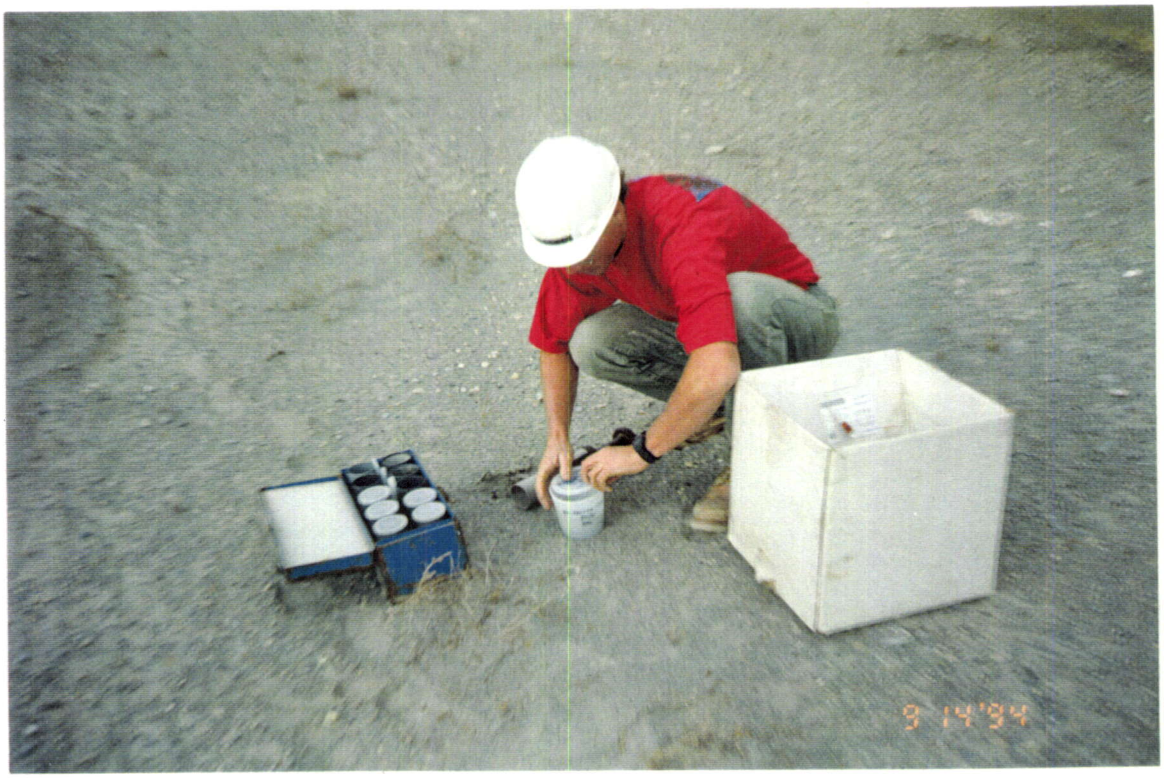

Figure 13 - Collecting chemical test samples

Figure 14 - Complete site after application and disking (note undisked biosolids next to tree)

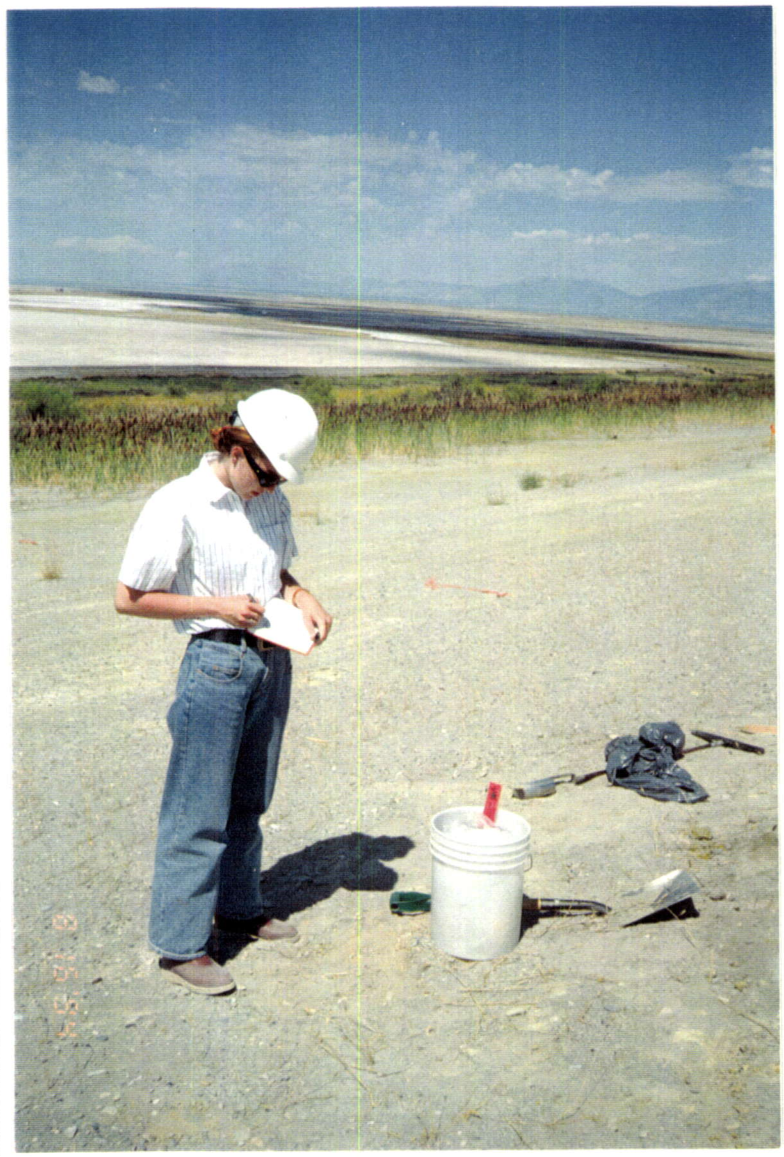

Figure 15 - Collecting agronomic samples

APPENDIX 1 - Calculation of AWSAR and Agronomic Rate

Appendix 1 uses the following abbreviations and sources:

1. APLR= Annual Pollutant Loading Rate, which is from Table 4 in CFR 503.13,
2. AVE.= Average value, in ppm, from CVWRF Report No. 11, 3 Jan to 31 Mar 1994,
3. (MAX)= Maximum values, in ppm, from CVWRF Report No. 11,
4. AWSAR= Annual Whole Sludge Application Rate, also from 40 CFR 503.13, and
5. Crop= Vegetation for which the agronomic calculations were performed, which is dryland wheat or grain, from "Utah Fertilizer Guide (EC 431).

AWSAR (Annual Whole Sludge Application Rate)

DATA: Pollutant concentrations from CVWRF (dry belt filter press cake), Report No. 11, 3/JAN/94 to 31/MAR/94 - average values as PPM - (maximum values in parenthesis)

	APLR (Table 4)		AVE. (MAX)		(mT/ha/365 day)	AWSAR (s ton/acre)
As	1.9	÷	4.3 (10.5)✓	x 1000 =	441.9 (180.9)	197.1 (80.7)
Cd	1.9	÷	5.6 (8.4)✓	x 1000 =	339.3 (226.2)	151.3 (100.9)
Cr	150	÷	55.7 (78.7)✓	x 1000 =	2,269.0 (1,906.0)	1,012 (850.1)
Cu	75	÷	574.5 (682.6)✓	x 1000 =	130.6 (109.9)	58.3 (49.0)
Pb	15	÷	121.2 (168.5)✓	x 1000 =	123.8 (89.0)	55.2 (39.7)
Hg	0.85	÷	3.5 (8.3)✓	x 1000 =	242.9 (102.1)	108.3 (45.5)
Mo	0.90	÷	64.2 (106.2)*	x 1000 =	14.2 (8.47)	6.3 (3.8)
Ni	21	÷	76.1 (262.2)✓	x 1000 =	275.9 (80.1)	123.1 (35.7)
Se	5.0	÷	35.9 (57.5)✓	x 1000 =	139.3 (87.0)	62.1 (38.8)
Zn	140	÷	948.9 (1,211.1)✓	x 1000 =	147.5 (115.6)	65.8 (51.6)

✓ = meets Table 1&3 (40 CFR 503), * = exceeds Table 1&3, but Mo is **not** considered (75 ppm)

✓ Based on AWSAR, do **not** exceed 35.7 s ton/acre/year

Agronomic Rate for nitrogen

K_v = 1.0 (dewatered sludge) - anaerobically digested

Biosolids

% solids	=	17.42% (average of 11/19/93 & 11/29/93, BFP cake)		
TKN	=	51,991.4 mg/Kg	"	"
NH_4-N	=	10,602.4 mg/Kg	"	"
NO_3-N	=	2.71 mg/Kg	"	"
ORGANIC-N	=	411,389.0 mg/Kg	"	"

Soil

pH = 2.7-8.0, but generally around 7.6 optimum 6.0-7.5 CEC = No Data

Residual N = 2-5 call it 3 mg/Kg = 0.003 kg/mt

Crop

80 lb/acre - N from "Utah Fertilizer Guide" (EC 431)

Dryland wheat or grain 70-90 lb/acre

Organic Rate

1. a. NH_4-N (kg/mt x K_v) = 10.6 kg/mt x 1.0 = 10.6 kg/mt
   b. Org-N x $F_{0.1}$ = 41.4 x 0.20 = 8.3 kg/mt
   c. NO_3-N = 0.003 kg/mt
   d. Total Available = 18.9 kg/mt
2. a. Background N in soil = 0.003 kg/mt
3. Nitrogen from other sources = 0 kg/mt
4. Total N from existing sources = 0 kg/mt
5. N crop requirement (80 #/acre)* = 89.7 kg/ha
6. Supplementary N needed from biosolids = 89.7 kg/ha
7. Agronomic Loading Rate (89.7/18.9) = 4.8 mt/ha or 2.1 tons/acre using dryland grain as the crop

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* need to compare to N fertilizer applications previously (e.g., if 10 lb/acre for success, then substitute this value in 5).

APPENDIX 2

Analytical Results from the Magna Improvement District - Wastewater Plant

FORD ANALYTICAL LABORATORIES

CHEMICAL AND BACTERIOLOGICAL ANALYSIS

DATE: 05/27/94 CERTIFICATE OF ANALYSIS

MAGNA IMP. DISTRICT
WASTEWATER PLANT
P.O. BOX 303
MAGNA, UT 84044

94-045010

SAMPLE: SLUDGE SAMPLE COLLECTED 5-12-94 RECEIVED 5-13-94 FOR ANALYSIS.

	Limits	Results	Method Detection Limit
- DRY WEIGHT BASIS			
Arsenic As mg/kg EPA 6010	75	7.35	1.00
Cadmium Cd mg/kg EPA 6010	85	8.7	1.0
Chromium Cr mg/kg EPA 6010	3000	34.3	1.0
Copper Cu mg/kg EPA 6010	4,300	713	1.00
Fecal Coliform/gram	2,000,000	<4000	
Lead Pb mg/kg EPA 6010	840	97	1.00
Mercury Hg mg/kg EPA 7471	57	5.3	.05
Molybdenum Mo mg/kg EPA 6010	75	21.4	1.0
Nickel Ni mg/kg EPA 6010	420	24.1	1.00
Selenium Se mg/kg EPA 6010	100	11.3	1.000
Total Solids % SM 2540 G	—	24.3	.05
Zinc Zn mg/kg EPA 6010	7,500	817	1.0

Joel Workman
FORD ANALYTICAL LABORATORIES

* ND - None Detected Above Specified Detection Limit *
Metals analysis performed at Chemtech.

50 West Louise Avenue • Salt Lake City, Utah 84115 • PHONE (801) 466-8761 • FAX (801) 466-8763

This page is a reference page used to track documents internally for the Division of Oil, Gas and Mining

Mine Permit Number M0350015 Mine Name KUC Tailings T
Operator Kennecott Utah Copper Date 2-6-1995
TO ______ FROM ______

__CONFIDENTIAL __BOND CLOSURE __LARGE MAPS X EXPANDABLE
__MULTIPUL DOCUMENT TRACKING SHEET __NEW APPROVED NOI
__AMENDMENT _OTHER______

Description YEAR-Record Number

__NOI X Incoming __Outgoing __Internal __Superceded

Demonstration Project for the Application of Biosolids in the Reclamation of the Tailings Impoundment

__NOI __Incoming __Outgoing __Internal __Superceded

__NOI __Incoming __Outgoing __Internal __Superceded

__NOI __Incoming __Outgoing __Internal __Superceded

__TEXT/ 81/2 X 11 MAP PAGES __11 X 17 MAPS __LARGE MAP

COMMENTS: ______

CC: ______